Inch Pound
Specification 2400-401
March 2003

UNITED STATES DEPARTMENT OF AGRICULTURE

FOREST SERVICE

SPECIFICATION FOR

RAIN-RESISTANT PAINT, TREE-MARKING WITH TRACER

1. SCOPE AND CLASSIFICATION.

1.1 Scope. This specification covers rain-resistant Tree-Marking Paint (TMP) intended to be readily visible and capable of testing positive for tracer presence 8 years after application. The paint is intended to be capable of drying (to the point of not washing off) within 30 minutes. There are two types of rain-resistant TMP, bulk and aerosol.

1.2 Classification. Rain-resistant TMP shall be of the following types, as specified.

Type C – rain-resisitant TMP available in six colors (yellow, orange, blue, green, white, and black) in bulk containers.

Type D – rain-resisitant TMP available in six colors (yellow, orange, blue, green, white, and black) in aerosol containers.

2. APPLICABLE DOCUMENTS.

2.1 Government Publications. The following documents form a part of this specification to the extent specified herein. Unless a specific year of issue is identified, the issue in effect on the date of this specification shall apply.

Federal Standards

FED-STD-141 – Paint, Varnish, Lacquer, and Related Paints; Methods of Inspection, Sampling, and Testing

MIL-STD-129 – Marking for Shipment (Federal Agencies)

FED-STD-313 – Material Safety Data, Transportation Data and Disposal Data For Hazardous Material Furnished To Government Activities

FED-STD-595 – Colors Used in Government Procurement

United States Department of Agriculture (USDA) – Forest Service, San Dimas Technology and Development Center (SDTDC)

9624 1808 –Tracer Paint Security Guidelines

Copies are available from USDA Forest Service, San Dimas Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773-3198; Phone: 909–599–1267.

United States Department of Transportation – Federal Highway Administration (FHWA)
Highway Color Tolerance Charts PR Color #1, and #6

Copies are available from Hale Color Charts, Inc., 11765 Old Frederick Road, Marriotsville, MD 21104; Phone 410–489–9569.

United States Environmental Protection Agency (EPA)
SW-846 – Test Methods for Evaluating Solid Waste

Copies are available from http://www.epa.gov/SW-846/txunder.htm.
Good Laboratory Practices

United States Food and Drug Administration
Laboratory Procedures Manual

National Institute for Occupational Safety and Health (NIOSH)
Manual of Analytic Methods

2016 – Formaldehyde

3500 – Formaldehyde by VIS

2.2 Other Publications. The following documents form a part of this specification to the extent specified herein. Unless a specific year of issue is identified, the issue in effect on the date of this specification shall apply.

American National Standards Institute (ANSI)
ANSI/ASQC Z1.4 – Sampling Procedures and Tables for Inspection by Attributes

Address requests for copies to the American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036.

American Society for Testing and Materials (ASTM)
D 185 – Test methods for Coarse Particles in Pigments, Pastes and Paints

D 1640 – Drying, Curing, or Film Formation of Organic Coatings at RoomTemperature

D 1729 – Visual Evaluation of Color Differences of Opaque Materials

D 2196 – Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield) Viscometer.

D 2243 – Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings

D 2244 – Calculation of Color Differences from Instrumentally Measured Color Coordinates

D 2697 – Volume Nonvolatile Matter in Clear or Pigmented Coatings

D 3924 – Standard Environment for Conditioning and Testing Paint, Varnish, Lacquer and Related Materials

D 3925 – Sampling Liquid Paints and Related Pigmented Coatings

D 3960 – Standard Practice for Determining Volatile Organic Compounds (VOC) Content of Paints and Related Coatings

D 4587 – Conducting Tests on Paint and Related Coatings and Materials Using a Fluorescent UV-Condensation Light- and Water-Exposure Apparatus

Copies are available from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

APA – The Engineered Wood Association
Voluntary Product Standard PS 1-95 for Construction and Industrial Plywood

Copies are available from the APA – The Engineered Wood Association, PO Box 11700, Tacoma, WA 98411. Web site: http://www.apawood.org

2.3 Order of Precedence. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence. However, nothing in this document supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS.

3.1 Qualified Products List Number. The paints furnished under this specification shall be products which are listed on the TMP Qualified Products List (Section 6.4). The manufacturer shall possess a currently valid notice of qualification with associated Qualified Products List (QPL) number obtained in accordance with Section 4.1. The date of issue for the QPL number shall precede the supplier's contract date.

3.2 Tracer Requirements. TMP shall contain both laboratory and field tracers. Field tracer will allow the TMP to be identified easily in the field, for comparison with non-tracer paints. Manufacturers shall contact the Qualifying Activity (Section 6.4.1) for information about, and approval for the use of, the field tracer. A laboratory tracer shall provide absolute identification of a manufacturer's product supplied under this specification, by analysis conducted by the manufacturer or a lab approved by the manufacturer. Testing for the presence of laboratory tracer will be paid for by the requester. To maintain uniqueness of tracer used in TMP, manufacturer and supplier shall never divulge the identity of the laboratory or field tracers as used in any product on the QPL. Manufacturer and supplier shall not supply the field or laboratory tracer to other buyers for a minimum period of 10 years after expiration or removal from the QPL. The TMP film shall test positive for the presence of both field and laboratory tracers for a minimum period of 8 years after the date of application.

3.2.1 Tracer Registration. The unique laboratory tracer shall be registered for the exclusive use of the United States (U.S.) Government. Only users who have been authorized by the Qualifying Activity (See 6.4.1) may order and use this product.

3.2.2. Field Tracer Identification. A test kit and instructions shall be available from the supplier that will enable trained personnel to determine the presence of field tracer in the TMP. The test kit shall be labeled specifically for the U.S. Government and show appropriate warnings for use. Ingredients shall not be listed on the test kits (see 29 CFR 1910.1200(i), Trade Secrets). Each test kit shall contain a minimum of 25 test applications. The field test method must be approved by the Qualifying Activity.

3.2.3. Tracer Analysis. For a period of 10 years following expiration or termination of a contract the manufacturer shall furnish, at no additional cost, interpretation and advice on laboratory analyses and reports to confirm presence, or absence, of the manufacturer's tracers. Additionally, occasional expert testimony may be needed from the manufacturer, which will be compensated at rates negotiated with the requesting U.S. Government Agency.

3.3 Quantitative Requirements.

3.3.1. TMP Types. Rain-resistant TMP shall be provided in two types. Paint shall be readily visible and capable of testing positive for tracer presence 8 years after application. Total solids shall be no less than 7 percent by volume.

Type C – rain-resisitant TMP available in six colors (yellow, orange, blue, green, white, and black) in bulk containers.

Type D – rain-resisitant TMP available in six colors (yellow, orange, blue, green, white, and black) in aerosol containers.

3.3.2. Limited Substances. The supplier is responsible for ensuring, and shall certify, that the paint does not contain metals or solvents in excess of the maximum levels shown in tables 1 and 2. The supplier is responsible for ensuring, and shall certify that, at the time of manufacture, the paint met all Federal and State requirements relating to air quality standards and maximum volatile organic compounds (VOC) contents.

Table 1—Total metals content.

Metals	EPA SW-846 Test Methods for Evaluating Solid Waste	Maximum Content as Metal (Percent Weight of Wet Paint)
Arsenic	EPA 6010, 6020, 7060, 7061, 7062, 7063	0.0049
Antimony	EPA 6010, 6020, 7040, 7041, 7062	0.039
Barium *	EPA 6010, 6020, 7080, 7081	0.01
Beryllium	EPA 6010, 6020, 7090, 7091	0.00021
Cadmium	EPA 6010, 6020, 7130, 7131	0.00015
Chromium	EPA 6010, 6020, 7190, 7191	0.044
Cobalt	EPA 6010, 6020, 7200, 7201	0.18
Lead	EPA 6010, 6020, 7420, 7421	0.01
Manganese	EPA 6010, 6020, 7460, 7461	0.23
Mercury	EPA 7470, 7471, 7472	0.007
Nickel	EPA 6010, 7910, 7911	0.43
Vanadium	EPA 6010, 6020, 7910, 7911	0.017
Zinc	EPA 6010, 6020, 7950, 7951	0.023

* The identified EPA test methods determine if barium is present, including oxidation states. If the identified standard for barium is exceeded, additional testing using Auger or ESCA analysis will be required to determine barium metal content.

If metals testing for barium is required using Auger or ESCA analysis, tests will be required at time of qualification in accordance with Section 4.1.2. Retesting will not be required for period of less than 1 year unless there is a change in source of supply or manufacturing process.

Table 2—Hazardous solvent content.

Solvent	EPA SW-846 Test Methods for Evaluating Solid Waste	Maximum Content as Solvent (Percent Weight of Wet Paint)
Benzene	EPA 8021B/8260B	0.0013
Xylene (all forms/isomers)	EPA 8021B/8260B	0.05
Trimethyl Benzene (all forms/isomers)	EPA 8021B/8260B	0.2
Toluene	EPA 8021B/8260B	0.01
Methyl Ethyl Ketone (MEK)	EPA 8015B/8260B	0.05
Methyl Isobutyl Ketone (MIBK)	EPA 8015B/8260B	0.0063
Diacetone (2-methyl-2-pentanol-4-one)	EPA 8015B/8260B	0.0063
Formaldehyde	NIOSH 2016/3500[1] EPA 8315	 0.00008
Methanol	EPA 8015B/8260B	0. 1
Mineral Spirits (Referenced to Stoddard reagent CAS 8052-41-3)	EPA 8260B/8021B	9.0
Chlorinated Solvents (Total): Carbon Tetrachloride, Chloroform, 1, 1-dichloroethane, Ethyl Chloride, Ethylene Dichloride, Hexachloroethane, 1,1,2,2-tetrachloroethane, Pentachloroethane, Methylene Chloride, Perchloroethylene, 1,1,1, 2-tetrachloroethane, 1,1,2-trichloroethane, 1, 1,1-trichloroethane (CAS 71-55-6), Trichloroethylene(CAS 79-01-6)	EPA 8260B/821B EPA 8270C/8121	0.0063
C_4 or Higher Alcohols (Total): n-Butyl, sec-Butyl, iso-Butyl, Allyl, iso-Amyl, Cyclohexanol	EPA 8015B/8270C EPA 8260B	0.0050
2-Methoxyethanol (CAS 109-86-4), 2-Ethoxyethanol (CAS 110-80-5), 2-Butoxyethanol (CAS 111-76-2 and acetates thereof (Total)	EPA 8015B/8430 EPA 8260B EPA 8270C	0.0063 0.0063 0.02

[1] NIOSH Methods 2016 or 3500 are intended for air sampling collection tubes. These methods should be modified for bulk analysis of liquid sample by the use of an appropriate head space analysis preparation or sparging such as the use of a Tek-Mar sparge and trap device to collect the formaldehyde.

3.4 Laboratory Tests. Procedures shall be used for demonstrating proficiency with each analytical method routinely used in the laboratory. These shall include procedures for demonstrating the precision and bias of the method as performed by each individual analyst on a specific instrument or series of instruments, and procedures for determining the Method Detection Limit (MDL). All terminology, procedures, and frequency of determinations associated with the laboratories establishment of the MDL and reporting limit shall be well-defined and documented. Documented precision, bias, and MDL shall be maintained for all methods performed in the laboratory in keeping with current Good Laboratory Practices as described by the U.S. Food and Drug Administration or U.S. Environmental Protection Agency.

3.4.1. Laboratory Analysis. To establish data and method validation, and equivalency for instances of deviation or substitution for the suggested methods, laboratory control samples shall be run with each analysis. These shall consist of a method blank, instrument blank, method spike, and duplicate (using the major solvents present in the sample in appropriate proportions spiked at the maximum allowed concentration for the analyte), matrix spike, and duplicate spiked at the maximum allowed concentration for the analyte. A randomly selected sample (ANSI/ASQC Z1.4) serves as the matrix. Analyte recovery and precision between spike duplicates shall be no less than 80 percent. A signal to noise ratio of at least 10:1 shall be measured for each analyte or grouping of combined analytes (e.g., Stoddard reagent).

3.4.2. Laboratory Deviations. Bracketing standards shall be run at a minimum of every fifth to tenth sample analysis during a run of 10 or more samples, and a duplicate standard, at the analyte limit concentration, at the completion of an analytical run. Deviation between consecutive standards shall not exceed 5 percent. Deviation between the initial and final standards shall not exceed 10 percent.

3.4.3 Laboratory Errors. Standard additions methods are recommended for instances where interferences or questionable appearance of analyte response is detected at or near the allowed limit when that limit is near the lab or analyst MDL.

Errors, deficiencies, deviations, or laboratory events or data that fall outside of established acceptance criteria shall be investigated. Where corrective action is needed to resolve the problem and restore proper functioning to the analytical system, the investigation and action shall be documented and provided with the material certification. The analytical report shall accompany and be a part of the certification documentation for each batch of the product which is produced at the same time using the same materials, process, and equipment. The raw data which supports the analytical report shall be kept on file and provided to the U.S. Government upon request. When there are errors and/or disputes in the analytical results, the material will be resubmitted to a neutral laboratory selected by the Qualifying Activity for final resolution.

3.5 Performance Requirements.

3.5.1 Condition in Container. TMP as received shall be ready for use and shall meet mixing requirements in Section 3.5.1.1.

3.5.1.1 Mixing Requirements. TMP shall require no more than 1 minute of stirring for 1 gallon (3.78 liter) and no more than 1 minute of hand-shaking for 1 quart (0.946 liter) or aerosol containers, to disperse the paint to a useable condition. When the paint is mixed in this manner the solids shall remain in suspension a minimum of 8 hours.

3.5.2 Color. In accordance with Section 4.4.3, the TMP shall match the central color specified on the Highway Color Tolerance Chart for yellow and orange. Blue, green, white, and black shall meet the description below:

Yellow: PR Color #1, max delta E of 6.0

Orange: PR Color #6, max delta E of 6.0

Blue: FED-STD-595 color 35260, max delta E of 6.0

Green: FED-STD-595 color 34350, max delta E of 6.0

White: ASTM D 2244 minimum reflectance of 80

Black: ASTM D 2244 maximum reflectance of 4

3.5.3 Spraying Properties.

3.5.3.1 Type C paint. Type C paint shall be capable of producing a 3- to 5-inch- (80- to130-mm-) diameter spot at a minimum distance of 6 feet (1.8 meters) at temperatures of –7 °C (20 °F) to 38 °C (100 °F) and relative humidities to 100 percent when tested in accordance with Section 4.4.4.1.

3.5.3.2 Type D paint. Type D paint shall deliver a minimum of 95 percent of net contents without sputtering or interruption at temperatures of –7 °C (20 °F) to 38 °C (100 °F) in accordance with Section 4.4.4.2. The nozzle(s) shall project a thin solid stream of marking paint at temperatures of –7 °C (20 °F) to 38 °C (100 °F) in accordance with Sections 4.4.4.2.1 and 4.4.4.2.2. The nozzle(s) shall be capable of writing numbers or letters and producing a solid band of marking paint at temperatures of –7 °C (20 °F) to 38 °C (100 °F) in accordance with Sections 4.4.4.2.1 and 4.4.4.2.2.

3.5.4 Adhesion. TMP shall have good adhesion to cold and to wet wood surfaces and shall show no evidence of blistering or film failure when tested as specified in Section 4.4.5.

3.5.5 Accelerated Weathering. TMP shall show no checking or peeling and the color change shall not be greater than a delta E value of 12 when tested as specified in Section 4.4.6. The field and laboratory tracers shall be detectable after weathering as specified in Sections 4.4.6 and 4.4.7.

3.5.6 Odor. In accordance with Section 4.4.8, the odor of the paint shall be approved by the National TMP Technical Sub-committee which performs an actual sniff test at time of paint application at the field site.

3.5.7 Contrast Ratio. In accordance with Section 4.4.9, the minimum contrast ratio of 12 mil of wet film shall be:

White, yellow, orange	0.90
Blue, green	0.95
Black	0.99

3.5.8 Sag Resistance. In accordance with Section 4.4.10, the sag resistance shall be a minimum of 8.

3.5.9 Dry Time. In accordance with Section 4.4.11, the dry hard time shall not exceed 48 hours and drying to the point of rain resistance at 90 percent relative humidity shall not exceed 30 minutes, in accordance with Section 4.4.11.1. TMP shall show no signs of thinning of the film, fading, or color change. There shall be no changes in the color of runoff water used in the test chamber.

3.5.10 Coarse Particles Test. In accordance with Section 4.4.12, the maximum acceptable percentage of grits retained on the sieve screen is 0.1 percent.

3.5.11 Freeze/Thaw Cycles. In accordance with Section 4.4.15, paint shall be able to withstand 5 cycles of freeze/thaw and maintain original condition.

3.5.12 Viscosity. In accordance with Section 4.4.16, the viscosity shall not exceed 800 centipoises or be less than 200 centpoises, measured at a speed of 100 rpm.

3.6 Containers.

3.6.1 Paint Containers. Type C paint shall be supplied in 1 quart (0.946 liter) and 1 gallon (3.78 liter) containers. Type D paint shall be supplied in aerosol containers of nominal 1 pint (0.473 liter) capacity.

3.6.1.1 Quart. Type C paint in all colors shall be supplied in 1 quart (0.946 liter) containers. These containers shall be metal cans of commercial construction with a round, conical top, having threads compatible with the Nelson Nelspot D-103 spray gun. These containers shall be filled to a minimum of 890 milliliter, and allow insertion of the Nelson spray gun without causing overflow. Press-in metal inner seals shall not be used on these containers.

3.6.1.2 One Gallon. Type C paint in all colors shall be supplied in 1 gallon (3.78 liter) Style F (oblong) containers.

3.6.1.3 Aerosol. Type D paint in all colors shall be supplied in commercial metal aerosol dispensers of nominal 1 pint (16 fluid ounces) (0.473 liter) capacity. These containers shall be filled to a minimum of 9 ounces (266 milliliters) of paint, exclusive of propellant or sprayability enhancers. Each container will be supplied with a nozzle(s). The color of the cap shall generically identify the color of the contents.

3.6.1.4 Special Marking. Container labels shall NOT indicate that the paint contains a tracer. Container labels shall:

1) Identify date of manufacture, batch number, and NSN.

2) Identify paint type (C or D) and color of contents.

3) Have Bar Code marking of NSN, and batch number.

4) State applicable warnings for use.

5) Identify the shelf-life expiration date.

3.6.2 Tracer Field Test Containers. Containers shall contain a minimum of 25 test applications. Container shall be of a type that can withstand forestry field use for a period of 8 years without deterioration or leaking. Cap shall be a screw-on type to avoid dislodging when working in the field. Bottle will be a soft bodied type that will not dispense test solution until squeezed. Bottle label information shall include date of manufacture and batch number. Instructions for use shall be included with each test kit.

3.7 Material Safety Data Sheet. A Material Safety Data Sheet (MSDS) shall be submitted in accordance with FED-STD-313.

4. SAMPLING, INSPECTION, AND TEST PROCEDURES.

4.1 Qualification Testing.

4.1.1 Manufacturer Submission for Qualification Tests. The prospective manufacturer shall provide to the Qualifying Activity:

a. A letter (as detailed in Section 6.3) listing the proposed tracers (Section 3.2.1) and requesting approval for their use. The manufacturer shall certify in this letter that the tracers which will be supplied have never been supplied by the manufacturer, in a form which could be construed as a tracer, in any paint to any consumer other than the USDA Forest Service.

b. Documentation and results demonstrating that the manufacturer's products have passed all of the tests described in the Performance Requirements (Section 3.5).

c. A signed agreement. For a copy of the form, contact the Qualifying Activity (Section 6.4.1).

d. An estimated test fee. Contact the Tree Marking Paint Project Leader at SDTDC for the current estimated test fee. All costs for Qualification Testing shall be borne by the manufacturer, except in the case of a small business, which may request Qualification Testing costs to be borne by the U.S. Government {see Federal Acquisition Regulation 9.204 (a)(2)}. If a product fails qualification testing the first time, all future qualification testing costs shall be paid by the manufacturer, even if it is a small business.

4.1.2 Additional Manufacturer Submissions. The manufacturer shall provide the following to both the Qualifying Activity and the analytical chemist (Section 6.4.2):

a. Documentation and results demonstrating that the manufacturer's products have passed all of the tests described in the Quantitative Requirements (Section 3.3).

b. A copy of all applicable Material Safety Data Sheets (Section 3.7).

4.1.3 Qualification Test. Qualification inspection and tests, or evaluation of submitted data shall be conducted by the U.S. Government and at the expense of the manufacturer (Section 4.1.1.d) at a fee to be determined by the U.S. Government. If requested by the manufacturer, the U.S. Government will inform the manufacturer of date and place of inspection and tests. The manufacturer may send a representative (who has been designated in writing) to be present and observe the inspection and tests, but they will not be permitted to be a participant. Upon completion of tests, the sample shall be retained by the U.S. Government. Qualification testing may be stopped on a single failure and the test sample rejected. The manufacturer will be informed as to the nature of the failure. The U.S. Government shall not be obligated to continue testing a defective product once it is known to be defective, or when it is considered to be in the best interest of the U.S. Government.

4.1.4 Field Tests. After the manufacturer has complied with requirements in Sections 4.1.1 and 4.1.2 to the satisfaction of the Qualifying Activity the manufacturer's product will be applied to four established field test sites by U.S. Government representatives who are selected by the Qualifying Activity. The four sites are maintained in Arizona, Wisconsin, Oregon, and South Carolina, and represent extremes in UV exposure, winter weather,

heavy rainfall, and high humdity respectively. Test sites may be relocated at the discretion of the Qualifying Activity. The product will be evaluated for performance under conditions similar to the actual intended use. The product must pass the field tests to the satisfaction of the Qualifying Activity, including:

a) field tracer (Section 3.2)

b) condition in the container (Section 3.5.1)

c) mixing (Section 3.5.1.1)

d) color (Section 3.5.2) when applied to a variety of tree species

e) spraying properties (Section 3.5.3) at the prevailing temperature and humidity

f) adhesion when applied to a variety of tree species (Section 3.5.4)

g) odor (Section 3.5.6)

h) dry time (Section 3.5.9)

4.1.4.1 Supplied Product. Samples must be submitted for each of the colors and types. Manufacturers shall supply seven 0.946 liter containers (Section 3.6.1) of each of the colors (Section 3.5.2) of each formulation they wish to qualify. One container of each color formulation and one field test kit (Section 3.2.2) shall be shipped to each of the four field test sites. Contact the Qualifying Activity for contact names and shipping addresses. Three containers of each color formulation and one field test kit (Section 3.2.2) shall be shipped to the Qualifying Activity, Tree Marking Paint Project Leader, unless otherwise notified.

4.1.4.2 Annual Review. The supplied products will be applied by the U.S. Government within 2 months of delivery (access and weather conditions permitting). For 8 years from the date of field test application, a U.S. Government representative(s) selected by the Qualifying Activity shall visit each test site on an annual basis to review product weather resistance including:

a) tracer performance (Section 3.2)

b) color (Section 3.5.2)

c) adhesion (Section 3.5.4)

Any product which is deemed by the Qualifying Activity to fail this review is subject to removal from the QPL.

4.1.5 Facilities. The manufacturer and supplier shall submit a written security plan to explain how they currently meet or will meet the *Tracer Paint Security Guidelines* (9624 1808 SDTDC). All production (including mixing, packaging, etc.) and distribution facilities (including shipping and return shipments) utilized by either the manufacturer and/or supplier will be reviewed by, and must be approved by, the Qualifying Activity as meeting the security guidelines in *Tracer Paint Security Guidelines*. All production (including mixing, packaging, etc.) and distribution facilities will be reviewed by the General Services Administration (GSA) for production and delivery capability. Production facilities will also be reviewed by GSA for quality-assurance testing facilities. GSA will provide the results of their reviews to the Qualifying Activity for evaluation and approval.

4.1.6 Formulation. The manufacturer shall have the complete product formulation and associated information available for review, if requested by the Qualifying Activity, to evaluate and approve the safety of the products for their proposed use. The Qualifying Activity shall treat this information as proprietary.

4.1.7 Notice of Qualification. Notice of Qualification shall be issued to the manufacturer upon the successful completion of qualification tests. Copies of qualification notices shall be provided to the GSA. A copy shall be retained in the Qualifying Activity file.

4.1.8 Notice of Failure to Qualify. The manufacturer shall be notified by letter of a failure to qualify if the submitted paint product does not meet the requirements of this specification.

4.1.9 Requalification. After qualification, if any changes are made in the formulation of a product; where it is manufactured, packaged, or distributed; or any change to the submitted written security plan, the maufacturer and/or the supplier shall notify the Qualifying Activity immediately in writing. The need for requalification shall be determined by the U.S. Government when there are changes to the product, production, distribution of the TMP, or to this specification. Less stringent testing requirements or extension of qualification may be allowed at the responsible agency's discretion (e.g., ISO 9001 certified manufacturers).

4.2 General Lot Inspection and Tests. Unless otherwise specified in the contract or purchase order, the supplier is responsible for performance of all inspection requirements as specified herein, except the accelerated weathering and odor requirements as specified in Sections 3.5.5 and 3.5.6, prior to submission for U.S. Government acceptance inspection and tests. The supplier may utilize their own facilities or any commercial laboratory acceptable to the U.S. Government. All inspection and test records shall be kept complete and available to the U.S. Government.

4.2.1 Inspection and Test Sites. The U.S. Government may conduct lot acceptance inspection and tests to determine compliance with the specification. If lot acceptance and tests are conducted at locations other than the manufacturing and/or packaging facilities, the contracting officer will specify the location and arrangements. In the case of onsite inspections at the manufacturer's or supplier's facility, the manufacturer or supplier shall furnish the inspector all reasonable facilities for their work. During any inspection, the inspector may take from any lot one or more samples and submit them to an independent test laboratory approved by the U.S. Government or to a U.S. Government test facility for inspection and tests.

4.2.2 Testing With Referenced Documents. The supplier is responsible for insuring that components and materials used were manufactured, inspected, and tested in accordance with referenced specifications and standards. The U.S. Government reserves the right to perform any of the inspections or tests set forth in this specification, where such action is deemed necessary to assure products, facilities, and security measures conform to this specification. All inspection or testing of a lot sample shall stop upon a single failure and the sample shall be failed. The supplier will be informed as to the nature of the failure. The U.S. Government shall not be obligated to continue testing a defective product once it is known to be defective or when it is considered to be in the best interest of the U.S. Government.

4.2.3 Responsibility for Compliance. All products shall meet all requirements of Sections 3 and 4. The inspection set forth in this specification shall become a part of the supplier's overall inspection system or quality program. The absence of any inspection requirements in this specification shall not relieve the supplier of the responsibility of ensuring that all products submitted to the U.S. Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective products, either indicated or actual, nor does it commit the U.S. Government to accept defective products.

4.3 Sampling for Inspection. When inspection is performed, sampling shall be in accordance with ASTM D 3925 or
SI/ASQC Z 1.4, as specified.

4.3.1 Inspection Classification. Inspections shall be classified as follows:

a) Qualification testing (Section 4.1)

b) Acceptance testing (Section 4.2)

c) Preparation for delivery (Section 4.3.1.3)

4.3.1.1 Qualification Testing. Qualification testing shall consist of tests for all requirements in Section 3. Field qualification testing shall be conducted by the Qualifying Activity. Laboratory testing shall be conducted by a laboratory approved by the Qualifying Activity. Failure to conform to any requirement may be cause to disqualify the paint for inclusion on the QPL under this Federal Specification.

4.3.1.2 Acceptance Testing. Acceptance testing of individual lots shall consist of tests for all requirements specified in section 3 except accelerated weathering and odor. Less stringent test requirements may be allowed at the responsible agency's discretion (e.g., ISO 9001 certified manufacturers).

4.3.1.3 Preparation for Delivery. A random sample of filled containers shall be selected in accordance with ANSI/ASQC Z1.4, inspection level S-2, acceptable quality level 2.5 percent, and examined for compliance with Sections 3.5.1, 3.5.2, 3.5.3, 3.5.4, 3.5.7, 3.5.8, 3.5.9, 3.6, and 5.

4.4 Test Methods. The supplier may sample for test prior to filling containers, but the U.S. Government shall sample the paint in accordance with ASTM D 3925. All testing shall be as specified in tables 1, 2, and 3 and as otherwise specified herein to determine compliance with the requirements of section 3. Unless otherwise specified, all tests shall be conducted at conditions specified in ASTM D 3924. Failure of any test shall be cause for rejection of the lot from which the sample was taken.

Table 3—Index.

Characteristic	Section	FED-STD-141	ASTM Method	Section
Tracer Requirements	3.2	—	—	4.4.1
Condition in container	3.5.1	3011	—	4.4.2
Color	3.5.2	—	D 1729, D 2244	4.4.3
Spraying Properties	3.5.3	—	—	4.4.4
Adhesion	3.5.4	—	D 1640	4.4.5
Accelerated Weathering	3.5.5	—	D 4587	4.4.6
Odor	3.5.6	—	—	4.4.8
Contrast Ratio	3.5.7	—	—	4.4.9
Sag Resistance	3.5.8	4494	—	4.4.10
Dry Time	3.5.9	—	D 1640	4.4.11
Coarse Particles Test	3.5.10	—	D 185	4.4.12
Freeze/Thaw Cycles	3.5.11	—	D 2243	4.4.15
Viscosity	3.5.12	—	D 2196	4.4.16
Total Solids	3.3.1	—	D 2697	4.4.13
Maximum VOC	3.3.2	—	D 3960	4.4.14

4.4.1 Tracer Requirements. After mixing, apply TMP containing tracer to separate 6 by 6 by 0.5 inch (150 by 150 by 12 millimeter) Medium Density Overlay (MDO) plywood (PS 1-95) panels and allow to dry. Use the field test kit supplied by the manufacturer to verify the presence of tracer and its uniqueness as required by 3.2 and 3.2.2.

4.4.2 Condition in Container. TMP will be mixed as specified in 3.5.1.1 One minute of stirring for 1 gallon (3.78 liter) and 1 minute of hand-shaking 1 quart (0.946 liter) or aerosol containers, to disperse the paint to a useable condition. Type C TMP will be sprayed using a Nelson Nelspot D-103 spray gun (Nelson Paint Company, One Nelson Drive, PO Box 2040, Kingsford, MI 49802) immediately after mixing and again after 8 hours.

4.4.3 Color. After mixing, the TMP shall be sprayed on a 6 by 6 by 0.5 inch (150 by 150 by 12 millimeter) MDO plywood (PS 1-95) panel to obtain complete hiding and allowed to dry for 48 hours. Yellow and orange shall be matched to the appropriate color chart specified in 3.5.2 in accordance with ASTM D 1729. Blue and green shall be matched to the specified color chip in accordance with ASTM D 2244. The reflectance at complete hiding (tristimulus value Y) shall be determined in accordance with ASTM D 2244 for white and black.

4.4.4 Spraying Properties.

4.4.4.1 Type C. After mixing, condition the Type C TMP in a quart container along with a Nelson Nelspot D-103 spray gun (use a 0.736 millimeter [0.029 inch] nozzle) at –7 °C (20 °F) for 8 hours. Spray paint from a distance of 6 feet (1.8 meters) onto a 6 by 6 by 0.5 inch (150 by 150 by 12 millimeter) MDO plywood (PS 1-95) panel using two trigger pulls with a pause of approximately one-half second between pulls. Heat the container and spray gun to 38 °C (100 °F) and repeat the test on a separate plywood panel. A spot 3 to 5 inches (80 to 130 millimeters) in diameter shall be produced at each temperature. Examine for compliance with 3.5.3.1.

4.4.4.2 Type D. Weigh the full aerosol containers before performing the test. Condition an aerosol container at –7 °C (20 °F) for 4 hours and hand shake for 1 minute. Container shall be sprayed until the paint sputters or the flow is interrupted. Invert container and dispel excess gas. The container shall be weighed to determine the weight of paint discharged. Return the container to room temperature. The can shall be opened and rinsed with solvent to remove the residual paint. Dry the can at 105 °C (221 °F) for 1 hour, cool and weigh to determine the weight of paint in the full container. Condition an aerosol container at 38 °C (100 °F) for 4 hours and hand shake for 1 minute. Repeat the above procedure. The percentage of paint discharged shall be in compliance with Section 3.5.3.2.

4.4.4.2.1 Low Temperature. Condition the aerosol container with nozzle at –7 °C (20 °F) for 4 hours and hand shake for 1 minute. Hold the container perpendicular to and 3.0 feet (1.0 meters) away from the verticle target. Depress the nozzle and hold open for 2 seconds. A spot no larger than 3 to 5 inches (80 to 130 millimeters) in diameter shall be produced on the target. Hold the container perpendicular and 1.0 feet (0.3 meters) or more away from the vertical target. Depress the nozzle and write a series of letters and numbers. Readable letters and numbers 8 inches or less in height shall be produced on the target. Results shall be in compliance with Section 3.5.3.2.

4.4.4.2.2 High Temperature. Condition the aerosol container at 38 °C (100 °F) for 4 hours and test with the nozzle(s) as in Section 4.4.4.2.1. Results shall be in compliance with Section 3.5.3.2.

4.4.5 Adhesion.

4.4.5.1 Adhesion to Cold Wood. Condition one piece of 6 by 6 by 0.5 inch (150 by150 by 12 millimeters) MDO plywood (PS 1-95) and the already mixed TMP at –7 °C (20 °F) for 4 hours. Apply the TMP by spraying to a wet film thickness of 4 mils (0.1 millimeters). Observe for proper film formation and immediately return the panel to the cold box. Remove the panel after 7 days cold exposure and allow to equilibrate to room temperature for 48 hours. Check for adhesion by performing the dry-through test as specified in section 7.7 of ASTM D 1640. Removal of any portion of the film shall constitute failure of the requirement in Section 3.5.4.

4.4.5.2 Adhesion to Wet Wood. Immerse one piece of 6 by 6 by 0.5 inch (150 by 150 by 12 millimeters) MDO plywood in water for 4 hours at room temperature. Remove from water and drain for 15 minutes. Apply the mixed TMP by spraying to a wet film thickness of 4 mils (0.1 millimeters). Allow to dry for 48 hours and check for adhesion by performing the dry-through test as specified in ASTM D 1640. Removal of any portions of the film shall constitute failure of the requirement in Section 3.5.4.

4.4.6 Accelerated Weathering.

4.4.6.1 Panel Preparation. Apply mixed TMP by spraying to a wet film thickness of 5 to 15 mils (0.13 to 0.38 millimeters) for full coverage on three 6 by 6 by 0.5 inch (150 by 150 by 12 millimeters) MDO plywood panels and air dry 7 days.

4.4.6.2 Exposure. Expose the panels to 700 hours accelerated weathering in accordance with ASTM D 4587. Use an exposure cycle of 4 hours flourescent UV at 60 °C followed by 4 hours of condensation at 40 °C. Use UV-B 313 lamps.

4.4.6.3 Evaluation. Examine the exposed panels for checking, peeling, and color change for compliance with Section 3.5.5. The color change shall be determined in accordance with ASTM D 2244 or ASTM D 1729 as applicable. Test TMP on plywood panels with the

field test method and submit the exposed panels for laboratory analysis to determine the presence of the tracer for compliance with Sections 3.2.2 and 3.2.3.

4.4.7 Weather Resistance. TMP will be applied to standing trees in several forest locations selected by the Qualifying Activity, and evaluated yearly for 8 years for adhesion, color retention, and tracer performance, and shall also be weathered as specified below.

4.4.7.1 Panel Preparation. As specified in 4.4.5.1.

4.4.7.2 Exposure. Expose three panels to 3 years weathering at a 45° southern exposure and three panels to 3 years weathering at a 45° northern exposure at Forest Products Laboratory, Madison, WI and/or Technology and Development Center, San Dimas, CA.

4.4.7.3 Evaluation. At the end of the 3 years of weathering, examine the exposed panels for checking, peeling and color change for compliance with Section 3.5.5. The color shall be examined as in 4.4.3. Test the paints with the field test method and submit the exposed panels for laboratory analysis to determine the presence of the tracer for compliance with Sections 3.2.2 and 3.2.3.

4.4.8 Odor. Odor of the paint is a subjective test which is conducted by those members of the National TMP Technical Subcommittee present at the time of application at a field site. A consensus of the members present determines pass or fail.

4.4.9 Contrast Ratio. TMP shall be applied on a black and white Leneta Card 2DX or equivalent, to 12 mils (0.3 millimeters) wet film thickness and allowed to dry 48 hours. The contrast ratio is the ratio of the reflectance of the paint on a black substrate, to that of an identical film on a white substrate. The reflectance Tristimulus Y may be measured using a spectrophotometer or colorimeter. The minimum contrast ratio shall be as required by Section 3.5.7.

4.4.10 Sag Resistance. In accordance with Section 3.5.8, the sag resistance shall be a minimum of 8, in accordance with the minimum requirements of FED-STD-141.

4.4.11 Dry Time. Use 4 mils (0.1 millimeters) wet film thickness on MDO plywood. TMP dry hard time shall not exceed 48 hours as required by Section 3.5.9 in accordance with ASTM D 1640.

4.4.11.1 Wash-off. Paint will be tested at two temperatures (a high and a low) and a relative humidity (RH) exceeding 90 percent. Test temperatures are 30 +/-2 °C (86 +/-3 °F) and 2 +/-2 °C (36 +/-3 °F). Prior to preparation of test panels, the test chamber will be brought to the proper operating temperature and RH for the test. TMP shall be applied to smooth MDO plywood (PS1-95) panels 6 by 10 by 0.5 inch (150 by 250 by 12 millimeters). Paint will be applied using a doctor blade to achieve a wet-film thickness of 6 mils. Panels are to be placed in the test chamber within 1 minute of being painted. All panels for a given test shall be prepared within 3 to 5 minutes. Test panels will be maintained in the test chamber at the required temperature and RH (without simulated rain) for 30 minutes. The simulated rain will be started and the test allowed to proceed for an additional 30 minutes. The color of the runoff water will be observed for changes during the 30 minutes of rain. Panels will be removed and checked for thinning of film, fading, and color changes as specified in Section 3.5.9.

4.4.12 Coarse Particles Test. Take a 3 inch (76 millimeter) No. 35 USA Standard Test Sieve (0.5millimeter [0.020 inch]) and dry it in an oven at 105 °C for 1 hour. Cool the sieve to room temperature and then weigh the sieve to the nearest mg to establish the tare

weight. Add 25g (+ or – 1g) of paint into a 5 ounce (150 milliliter) glass beaker. Add 3.4 ounces (100 milliliters) of solvent to the paint and mix with a glass stirring rod. Pour mixture through the sieve. Stirring rod and beaker shall be rinsed clean, being sure that all of the paint goes through the sieve. The sieve will be carefully rinsed to be sure all pigment is removed and all that remains on the sieve screen are the solid coarse particles. The sieve shall then be dried in an oven at 105 °C for 1 hour. The sieve shall be cooled to room temperature and reweighed to the nearest milligram. The following formula will establish the percentage of coarse particles retained on the sieve screen:

$$\frac{\text{(Sieve + Grits) – (Sieve Tare Wt)}}{\text{grams of paint used}} \quad \text{X 100 = Grits Percent}$$

The percentage of grits remaining on the sieve screen shall not exceed the maximum acceptable precentage of 0.1 percent as required by Section 3.5.10 in accordance with ASTM D 185.

4.4.13 Total Solids. Manufacturers may calculate this requirement from batch card data but in case of dispute the method specified (ASTM D 2697) in table 3 must be used.

4.4.14 Maximum Volatile Organic Compound (VOC). Maximum VOC content is to conform to the most restrictive State or Federal standard in affect at the time of manufacture. Tests shall be conducted according to ASTM D 3960. Type D (aerosol) used in California shall meet the Product-Weight Maximum Incremental Reactivity (PW-MIR) requirements of California Code Regulations, Title 17, Division 3, Chapter 1, Subchapter 8.5, Article 3, Section 94522.

4.4.15 Freeze/Thaw Cycles. Paint will be conditioned and tested in accordance with ASTM D 2243 as specified in Section 3.5.11.

4.4.16 Viscosity. Test in accordance with ASTM D 2196 using a test speed of 100 rpm to requirements specified in Section 3.5.12.

5. PREPARATION FOR DELIVERY.

5.1 Packaging, Packing and Marking. TMP shall be furnished in quantities specified (Section 6.2). The containers shall be in accordance with Section 3.6. The packaging shall be as otherwise specified (Section 6.2). Marking shall be in accordance with MIL-STD-129.

5.2 Documentation of Shipping Procedures. In order to facilitate the shipping procedures included in the supplier’s security plan submitted under Section 4.1.5, each shipped unit shall include the supplier’s address and a toll free telephone number for contact in case of lost or damaged shipments.

6. NOTES.

6.1 Intended Use. This description covers rain resistant paints for marking and identifying trees. Marking paints are intended to provide a service life of 8 years after application. The paint is suitable for application through a temperature range of -7°C (20 °F) through 38 °C (100 °F).

6.2 Ordering Data. Purchasers should include the following information in procurement documents:

a) Title, number, and date of this specification.

b) Color(s) required (Section 3.5.2).

c) Quantity and size of container required (Section 3.6).

d) Packaging and packing level.

e) Instructions and address for submission of MSDS (Section 3.7)

6.3 Tracer Registration. Tracers are required to be registered for the exclusive use of the U.S. Government. To register as such, the manufacturer shall submit by registered letter; eyes only; return receipt required; a request for registration with sufficient description of the tracer to the Qualifying Activity where it will be recorded and filed.

6.4 Qualification. The contracting officer should verify that the manufacturer possesses a currently valid notice of qualification with the associated TMP - Qualified Products List (QPL) number obtained in accordance with Section 4.1. This QPL number shall have already been obtained with a date of issue prior to the closing date of the invitation for bids, whether or not such products have actually been added to the TMP – QPL by that date.

6.4.1 Qualifying Activity. The activity responsible for managing the TMP – QPL is: USDA Forest Service, Tree Marking Paint Project Leader, San Dimas Technology and Development Center (SDTDC), 444 E Bonita Avenue, San Dimas, CA 91773-3198.

6.4.2 Analytical Chemist. Dr. Ron Foster, Engineering Division 6FETA, GSA Hardware and Appliances Center, 1500 East Bannister Road, Bldg. 6, Kansas City, MO 64131-3088.

6.5 New Product Development. To assist manufacturers in their development efforts, small quantities (5 quarts or less) of TMP can be sent to Regional Representatives, who are official members of the National TMP Committee, for field test application and feedback on performance and employee exposure. These members are defined by the Qualifying Activity. This developmental paint shall be supplied at no cost to the U.S. Government.

6.6 Field User Testing. Field users will conduct monitoring tests under the direction of the Qualifying Activity. The results will be forwarded to the Qualifying Activity who will initiate the appropriate steps for corrective action if required.

6.7 Preparing Activity. USDA Forest Service, San Dimas Technology and Development Center, 444 East Bonita Avenue, San Dimas, CA 91773-3198.

6.8 Contracting Agency. The General Services Administration (GSA) is the U.S. Government agency that will contract the acquistion of TMP.

6.9 Responsible Agency. The USDA Forest Service is the agency responsible.